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TC 1700 MAIL ROOM

AMENDMENTS

Applicants respectfully request that the following amendments to the claims be entered. Pursuant to 37 C.F.R. §§ 1.121 (b) and (c), the proposed amendments are provided both in marked (Appendix A) and unmarked versions (below):

In the Claims:

- Please amend claims 1, 7, 10 – 12, 16, 19, 20, 21, 23, 24, 28 and 29 without prejudice or disclaimer as indicated below. Please add new claim 30. An unmarked version of all of the claims that are believed to be presently pending before the office is set forth below. A marked set of claims is set forth in Appendix A. Amendment of such claims is made in order to streamline prosecution in this case by limiting examination and argument to certain embodiments of the invention that presently are considered to be of immediate commercial significance. Amended claims that may be construed as more limiting than the scope of the claims prior to amendment should not be construed as an abandonment of any subject matter no longer claimed, nor should the amended claims be construed in any manner to waive or limit the equivalent structures of any element recited in such claims that would otherwise be available under the Doctrine of Equivalents with respect to the unamended claims. Amendment of the claims is not in any manner intended to, and should not be construed to, waive Applicants' right in the future to seek such claimed subject matter, or similar matter, whether in an equivalent, broader or narrower scope, in any continuation, divisional, continuation-in-part, RCE, CPA or any other application claiming priority to or through the present application. Applicants expressly reserve the right to file such applications directed to the subject matter included in the unamended claims.

UNMARKED VERSION OF AMENDMENTS

- A1
1. **(Once Amended)** A process for the preparation of low molecular weight linear alpha olefins having 4 to 24 carbon atoms, comprising oligomerising ethylene in an inert aliphatic or aromatic solvent in the presence of a catalyst including at least two components, a first component selected from the group consisting of zirconium alkoxide and zirconium aryloxide in association with free alcohol in a ratio of about 1:0.33 to about 1:2.3, and a second component selected from the group consisting of an alkyl aluminum and/or alkyl aluminum halide component.
  2. A process as claimed in claim 1 wherein the process is carried-, out under a continuous supply of ethylene and under agitation.
  3. A process as claimed in claims 1 wherein the process is performed in semi-continuous mode with ethylene being fed continuously during each period of the process.
  4. A process as claimed in claim 1 wherein the catalyst system comprises of at least two components, the first component comprising of zirconium (IV) alkoxide or carboxylate and the second component comprising of triethylaluminum and/or ethylaluminum sesquichloride.
  5. A process as claimed in claim 1 wherein the catalyst is of the formula  $Zr(OR)_4-Et_3Al$  wherein R is alkyl or aryl.
  6. A process as claimed in claim 1 wherein the catalyst is of the formula  $Zr(OR)_4-Et_3Al_2Cl_3$  wherein R is alkyl or aryl.
  7. **(Once Amended)** A process as claimed in claim 1 wherein the catalyst is of the formula  $Zr(OR)_4Et_3Al$  and/or  $Zr(OR)_4Et_3Al_2Cl_3$  wherein R is alkyl or aryl.
  8. A process as claimed in claim 5 wherein  $Et_3Al$  is reacted with  $Zr(OR)_4$  in the mole ratio of 10:1 to 60:1.
- A2

9. A process as claimed in claim 6 wherein  $\text{Et}_3\text{Al}_2\text{Cl}_3$  is reacted with  $\text{Zr}(\text{OR})_4$  in the mole ratio of 10:1 to 60:1.

10. **(Once Amended)** A process as claimed in claim 7 wherein  $\text{Et}_3\text{Al}$  and/or  $\text{Et}_3\text{Al}_2\text{Cl}_3$  is reacted with  $\text{Zr}(\text{OR})_4$  in the mole ratio of 10:1 to 60:1.

11. **(Once Amended)** A process as claimed in claim 4 wherein zirconium alkoxide is in association with the free alcohol in a concentration ratio range of 1:0.33 to 1:1.3.

A3 12. **(Once Amended)** A process as claimed in claim 7 wherein when both  $\text{Et}_3\text{Al}$  and  $\text{Et}_3\text{Al}_2\text{Cl}_3$  are used, the  $\text{Et}_3\text{Al}$  diluted in solvent is initially charged into the reactor and then  $\text{Et}_3\text{Al}_2\text{Cl}_3$  and other catalyst components are added therein.

13. A process as claimed in claim 1 wherein the ethylene pressure is in the range of 18 to 38  $\text{kg}/\text{cm}^2$ .

14. A process as claimed in claim 1 wherein the oligomerisation is carried out at a temperature in the range of  $80^\circ\text{C}$  to  $140^\circ\text{C}$ .

15. A process as claimed in claim 1 wherein, the process is carried out for a time period in the range of 1 hour to 3 hours.

A4 16. **(Once Amended)** A process as claimed in claim 1 wherein, the solvent used is selected from the group consisting of: cyclohexane, toluene and n-octane.

17. A process as claimed in claim 2 wherein the reaction is carried out at an agitator speed of 300 to 1000 rpm.

18. A process as claimed in claim 1 wherein, the zirconium component is selected from the group consisting of zirconium tetra cresylate, zirconium tetra dimethyl phenolate, zirconium tetra n-butoxide, zirconium tetra iso-propoxide, zirconium tetra n-propoxide, zirconium tetra butyrate and zirconium tetra isobutyrate.

19. (Once Amended) A process as claimed in claim 1 wherein said catalyst includes a thiophene as a third component to reduce chain growth.

AS 20. (Once Amended) A process for the preparation of low molecular weight linear alpha olefins having 4 to 24 carbon atoms, comprising oligomerising ethylene in an inert aliphatic or aromatic solvent in the presence of a catalyst  $\text{Zr(OR)}_4\text{-Et}_3\text{Al}$  and/or  $\text{Zr(OR)}_4\text{-Et}_3\text{Al}_2\text{Cl}_3$  wherein R is alkyl or aryl, at a pressure is in the range of 18 to 38  $\text{kg/cm}^2$ , a temperature in the range of  $80^\circ\text{C}$  to  $140^\circ\text{C}$  for from 1 hour to 3 hours.

21. (Once Amended) A process as claimed in claim 17, wherein the mole ratio of  $\text{Et}_3\text{Al}$  and/or  $\text{Et}_3\text{Al}_2\text{Cl}_3$  to  $\text{Zr(OR)}_4$  is 10:1 to 60:1.

22. A process as claimed in claim 17 wherein the reaction is carried out at an agitator speed of 300 to 1000 rpm.

AB 23. (Once Amended) A process as claimed in claim 17 wherein said catalyst includes a thiophene as a third component to reduce chain growth.

24. (Once Amended) A process as claimed in claim 17 wherein said solvent is selected from the group consisting of: toluene, n-Octane and cyclohexane.

25. A process for the preparation of low molecular weight linear alpha olefins having 4 to 24 carbon atoms, comprising oligomerising ethylene in an inert aliphatic or aromatic solvent in the presence of a catalyst  $\text{Zr(OR)}_4\text{-Et}_3\text{Al}_2\text{Cl}_3$  wherein R is alkyl or aryl, at a pressure is in the range of 18 to 38  $\text{kg/cm}^2$ , a temperature in the range of  $80^\circ\text{C}$  to  $140^\circ\text{C}$  for from 1 hour to 3 hours.

26. A process as claimed in claim 25, wherein the mole ratio of  $\text{Et}_3\text{Al}_2\text{Cl}_3$  to  $\text{Zr(OR)}_4$  is 10:1 to 60:1.

27. A process as claimed in claim 25 wherein the reaction is carried out at an agitator speed of 300 to 1000 rpm.

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28. (Once Amended) A process as claimed in claim 25 wherein said catalyst includes a thiophene as a third component to reduce chain growth.
29. (Once Amended) A process as claimed in claim 25 wherein said solvent is selected from the group consisting of: toluene, n-Octane and cyclohexane.
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30. (New) The process of claim 1 wherein the process is active in the absence of zirconium tetrahalide.
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#### STATUS OF PENDING CLAIMS AFTER INCORPORATION OF AMENDMENTS

Claims 1 - 30 are now pending in the application. Claims 1, 7, 10 - 12, 16, 19, 20, 21, 23, 24, 28 and 29 are amended herein. Claims 1, 20 and 25 are independent claims. Claims 2 - 19 depend on claim 1, claims 21 - 24 depend on claim 20 and claims 26 - 29 depend on claim 25. Claim 30 is new and depends on claim 1. Support for new claim 30 is found, among other places, at pages 4 - 9 of the specification.

#### REMARKS ON THE OFFICE ACTION OF JUNE 19, 2002

##### RESPONSE TO CLAIM OBJECTIONS

- The Examiner's Position:

The Examiner has objected to claims 19, 23 and 28 due to the incorrect spelling of "thiophene" as "thiopene." The Examiner requires appropriate correction and review of the specification for similar misspelling.

- Applicants' Position:

Applicants have amended claims 19, 23 and 28 to correct for the error noted by the Examiner. Applicants' review did not note a similar error in the specification. Applicants

respectfully assert that such amendments overcome the Examiner's claim objections and respectfully request that such objections be withdrawn.

### **RESPONSE TO REJECTIONS**

#### **In the Claims:**

- **Claim Rejections under 35 U.S.C. § 112, Second Paragraph**

- **The Examiner's Position:**

The Examiner has rejected claims 1 - 29 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicant regards as the invention (page 2, paragraph 3, of the Office Action). The Examiner asserts that with respect to claims 1 and 4 that the selection of the first and second component should be recited in "proper Markush format" (page 2, paragraph 4, of the Office Action), and similarly with respect to claim 16, 24 and 29 ,that "proper Markush format" should be set forth with respect to the selection of diluents (page 2, paragraph 7, of the Office Action). With respect to the term "free alcohol" on line 1 of claim 11, the Examiner asserts that the term lacks a clear antecedent basis (page 2, paragraph 5, of the Office Action). Lastly, with respect to claims 7, 10, 12, 20, and 21 the Examiner asserts that the claims need to be clarified in respect of whether both aluminum compounds are used in the oligomerization reaction.

- **Applicants' Position:**

Applicants respectfully traverse the Examiner's position on the basis that a person of ordinary skill in the art would understand the claims as drafted as particularly pointing out and distinctly claiming the subject matter thereof. However, in order to expedite prosecution in this case, Applicants have amended claims 1, 4, 16, 24 and 29 to incorporate classic Markush group language, and have amended claims 7, 10, 12, 20 and 21 to make clear whether both or either aluminum compound is being recited in the claim as an element thereof. In terms of claim 11, Applicants have amended the claim such that any antecedent basis problem has been rectified. Applicants therefore respectfully request that the Examiner withdraw his 35 U.S.C. §112, second paragraph, rejections.

- **Claim Rejections under 35 U.S.C. § 102(b):**

- **The Examiner's Position:**

The Examiner has rejected claims 1 – 3, 13 – 16 and 18 under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 4,409,414 to Langer, Jr. ("Langer Jr. '414 reference"). The Examiner asserts that the Langer Jr. '414 reference "discloses a batch/continuous process of making alpha-linear olefins having applicants' claimed range of number of carbons by oligomerizing ethylene in the presence of a catalyst containing zirconium alkoxide such as  $Zr(OBu)_4$  and alkyl aluminum halide, in the presence of a diluent such as toluene under the condition of a temperature ranging from below 125°C, a pressure ranging from 50 psia such as 500 psia, during the applicants' claimed time and high-speed stirring" (page 3, paragraph 3, of the Office Action).

- **Applicants' Position:**

Applicants' comments are directed to the amended claims.

Applicants respectfully traverse the 35 U.S.C. §102(b) rejection on the basis that every element of the amended claims is not found in the Langer Jr. '414 reference. For example, Applicants note no teaching in the Langer Jr. '414 reference that the zirconium alkoxide or zirconium aryloxide component be in association with free alcohol in a ratio of about 1:0.33 to about 1:2.3 as set forth in amended independent claim 1. As noted on pages 4 – 5 of the specification, without adequate free alcohol the zirconium component may undergo oligomerization to give an inorganic oligomer that has no activity. Respectfully the Langer Jr. '414 reference does not teach the same. As claims 2 – 3, 13 – 16 and 18 depend from claim 1, and therefore claim something less, it is likewise asserted that these claims are anticipated by the Langer Jr. '414 reference.

In respect of new claim 30, Applicants note that such claim is specifically taught away in that the Langer Jr. '414 reference clearly teaches that an "essential aspect of ... [its] invention is

the first component of the catalyst [being] an adduct of zirconium tetrahalide" (col. 3, lines 23 – 24).

- **Claim Rejections under 35 U.S.C. § 103(a):**

- **The Examiner's Position:**

The Examiner has rejected claims 4 – 12, 17, 19, 20 – 22, 23, 24 – 27, 28 and 29 under 35 U.S.C. §103(a). Claims 17 is rejected as being unpatentable over the Langer Jr. '414 reference, claim 19 as being unpatentable over the Langer Jr. '414 reference in view of U.S. Patent No. 5,260,500 to Shiraki *et al.* ("Shiraki *et al.* '500 reference"), claims 4 – 12, 20 – 22, 24 – 27 and 29 in light of the Langer Jr. '414 reference in view of U.S. Patent No. 4,855,525 to Young *et al.* ("Young *et al.* '525 reference"), and claims 23 and 28 in light of the Langer Jr. '414 reference in view of U.S. Patent No. 4,855,525 to Young *et al.* ("Young *et al.* '525 reference") and further in view of the Shiraki *et al.* '500 reference. The Langer Jr. '414 reference is said to disclose high-speed stirring (page 4, paragraph 3, of the Office Action), a batch/continuous process of making alpha-linear olefins in the presence of a catalyst containing zirconium alkoxide and alkyl aluminum halide in the presence of a diluent such as toluene (page 3, paragraph 3). The Shiraki *et al.* '500 reference is said to disclose adding thiophene into a catalyst used in producing linear alpha olefins "to improve the purity of the linear alpha olefins" (page 5, paragraph 3, of the Office Action). The Young *et al.* '525 reference is said to "disclose[]" that aluminum compounds such as  $R_3Al_2X_3$ ,  $AlR_2X$ ,  $AlR_3$ , and  $AlRX_2$  are equivalent components for oligomerization catalysts with X being Cl, R being ethyl" (page 5, paragraph 7, of the Office Action).

- **Applicants' Position:**

Applicants respectfully traverse the Examiner's 35 U.S.C. § 103(a) rejections based in part on the failure of the Examiner to recite adequate motivation for combining the references in the manner indicated, and based in part on the inappropriate use by the Examiner of "hindsight reasoning" in an attempt to "approximate" the present invention.



With respect to claims 4 – 12, 17 and 19, it is pointed out that all of these claims depend upon independent claim 1. Independent claim 1, as noted above, in part distinguishes over the Langer Jr. '414 reference in that it now recites that the zirconium alkoxide or zirconium aryloxide component is in association with free alcohol in a ratio of about 1:0.33 to about 1:2.3. Support for such limitation is found in claim 11 as originally filed (which is therefore part of the original disclosure). As explained in the specification at pages 4 – 5, the free alcohol prevents oligomerization of the zirconium component to itself which may eventuate in an oligomer that is ineffective for the process claimed. Respectfully, such limitation is not made obvious by the Langer Jr. '414 reference. With respect to claim 12, furthermore, it should be noted that neither the Langer Jr. '414 reference, Shiraki *et al.* '500 reference, nor Young *et al.* '525 reference, either alone or in combination, suggest the particular sequence of addition cited therein. Such sequence enhances the production and is preferred as indicated at page 5 of the specification.

It should be noted that new claim 30 further distinguishes over the Langer Jr. '414 reference in reciting that the process of claim 1 is active in the absence of zirconium tetrahalide. The Langer Jr. '414 reference clearly teaches that an “essential aspect of ... [its] invention is the first component of the catalyst [being] an adduct of zirconium tetrahalide.”

With respect to claims 4 – 12, 20 – 22, 23, 24 – 27, 28 and 29, respectfully the Examiner's reasoning is also flawed. Recognizing that the Langer Jr. '414 reference does not disclose the aluminum compounds called for in these claims (See, page 5, paragraph 7, of the Office Action), the Examiner looks to the Young *et al.* '525 reference where such compounds are said to be disclosed. The problem of course arises in that the Young *et al.* '525 reference discloses such aluminum compounds being strictly used with respect to a catalyst having adduct of zirconium tetrahalide as a component, certainly not referenced in such claims. Likewise, the Langer Jr. '414 reference requires that the reaction product of the transition metal halide be with an aluminum alkyl compound of a formula that does not reach the aluminum compounds recited in such claims. There is simply no motivation for ignoring such requirements and combining the two different components in the manner asserted in the claims, and furthermore in choosing the particular components recited in such claims. Nor is there a reasonable expectation that such combination would be work for the process recited.

Furthermore, Applicants note that the Langer Jr. '414 reference reports that with  $\text{AlEt}_2\text{Cl}/\text{AlEt}_2\text{Cl}_2/\text{Zr}(\text{OPr})_4$  system that  $M_n$  of the alpha olefins is 188 and 141 (Table IV). This suggests maximum selectivity to  $\text{C}_{12}$  -  $\text{C}_{13}$  and higher alpha olefins only (see, col. 11, example 7, paragraph 2). As disclosed in the specification, a catalyst system of the present invention can yield lower range of alpha olefins, *e.g.*,  $\text{C}_4$  -  $\text{C}_{10}$ .

### CONCLUSIONS

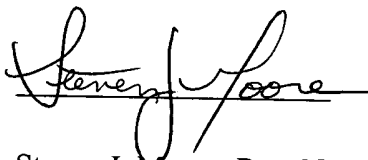
In view of the above, it is respectfully submitted that the subject matter of the pending claims which were rejected under 35 U.S.C. §§102, 103(a), and 112, second paragraph, are patentable over the references of record. An early notice of allowance is therefore earnestly requested.

### REQUEST AND PAYMENT FOR TWO-MONTH EXTENSION FEE

Applicant hereby requests a two month extension to the shortened statutory response period be granted. A check for the sum of \$400 is enclosed to cover the same (large entity fee). However, the Commissioner is hereby authorized to charge any fees that may be required, or credit any overpayment, to Deposit Account 033-975.

Respectfully Submitted,

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